

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER 79-04-03	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) A CONCEPT OF CORPORATE MEMORY		5. TYPE OF REPORT & PERIOD COVERED Technical Report
		6. PERFORMING ORG. REPORT NUMBER 79-04-03
7. AUTHOR(s) Howard L. Morgan David J. Root		8. CONTRACT OR GRANT NUMBER(s) N00014-75-C-0462
9. PERFORMING ORGANIZATION NAME AND ADDRESS Department of Decision Sciences The Wharton School Philadelphia, PA 19104		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS Task NRO49-272
11. CONTROLLING OFFICE NAME AND ADDRESS Office of Naval Research Department of the Navy 800 N. Quincy St., Arlington, VA 22217		12. REPORT DATE May 17, 1979
		13. NUMBER OF PAGES 6
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) corporate memory, office automation systems, management information systems, segmented memory		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) We have begun to describe a concept of "corporate memory" which attempts to provide information systems support to the organiza- tion as a whole. We examine the propositions that organizations incur higher information gathering costs than individuals and higher lost opportunity costs. The corporate memory system is a logical extension to the office automation concepts being widely discussed today. A proposed design and some examples of potential utility of corporate memory systems are presented.		

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This paper will be presented at the NYU Office Automation
Conference, May 17, 1979

This research was supported in part by the Office of
Naval Research under Contract N00014-75-C-0462.

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Abstract

An organization often has much information which is not effectively utilized. We have begun to describe a concept of "corporate memory" which attempts to provide information systems support to the organization as a whole, rather than to a particular individual. We examine the propositions that organizations incur higher information gathering costs than individuals (due to the need for relearning things already known elsewhere in the organization) and higher lost opportunity costs (caused by not having information known in one part of the organization available to other parts). The corporate memory system is a logical extension to the office automation concepts being widely discussed today. A proposed design and some examples of potential utility of corporate memory systems are presented.

1.0 INTRODUCTION

Most office automation systems (and most other computer based information systems) which have been designed to date have been aimed at aiding individuals. We often speak of ensuring that the systems we build will be focused on "user" needs, where the user is some specified individual (or class of individuals). If one takes as a premise that the true purpose of office automation and other management information tools is to aid the organization be more effective, the current designs for systems may be missing the point. Systems should be designed primarily to aid the organization, rather than to help individuals. It is not at all clear that optimizing the information resources available to any individual manager will optimize the utilization of information in the organization. In this paper, we will discuss some of the issues in creating a "corporate memory", defined below, system which is designed to aid an organization as a whole.

Of course, since it is individuals who have to interface with the system, considerations of human factors, ergonomics, and other standard aspects of system design are still important. Having the organizational considerations as paramount introduces several difficulties:

1. Differences, amongst the individuals, in preferences.
2. Differences, amongst the individuals, in beliefs about the outcomes of events and the state of the world.
3. Uncertainty, on the part of individuals, about the actions of the other members of the organization.
4. Differences, amongst the individuals, in cognitive style.
5. Segmented memory, i.e. separate repositories of knowledge scattered throughout the organization.

In this paper we focus on the last item. The problems of a segmented memory are of course a very obvious target of conventional MIS design & implementation. However, as pointed out by Mintzberg [13], these MISs tend not to include a major portion of the information which managers regard as vital to their function. The sources of knowledge/information which a manager does use include:

Personnel
 Personal Files
 Procedure Manuals/Formal Policies
 Informal Policies/Managerial Myths
 Journals, Newsletters, etc.
 Organization's Data Base(s)
 Organization's Model Base(s)
 External (to Organization) Data Base(s)

Of these, a few are incorporated into conventional MIS, one or two additional ones are incorporated into modern office

automation systems, and others are completely left out.

We call the totality of all the above information sources, for all the individuals in the organization, the corporate memory. Krippendorf [12] has discussed some of the information storage and retrieval principles associated with a "social memory", in the broader context of society. This paper explores some of the possibilities of creating a computer based corporate memory, utilizing the technologies of office automation, communications, decision support systems and artificial intelligence. The use of the word "memory" implies that the system is more than a passive databank. Rather we view a corporate memory as an active system, initiating interactions with users as well as responding to requests.

Many instances of organizations making at least simple efforts in this area have occurred recently. About a year ago, the Wall Street Journal carried an article about the practice of many corporations to retain retired employees as consultants. The function of these retired employees is to a large extent to act as information directories, answering questions such as 'Who do we see about ...?'. This relates to the idea expressed by Herbert Simon [16], 'Everything I know is in the heads of my friends.'. This type of information network can cause difficulties in organizations when a new person takes over someone's job. In the beginning he will not have much of this information network available to him.

Another example of trying to aid the flow of information between the various segments of the organization is the recent practice adopted by Lanier [4] to pay service personnel for sales leads resulting in sales. When a service person hears about a potential customer, the sales lead is in the corporate memory. Unfortunately, without the fee incentive it was not transmitted to the sales force. The concept of finders fees is not new, however, usually they have involved large sums being paid to people outside the organization, or to salesman not involved in the actual sale. Lanier is tapping a large internal source of information at small costs.

We propose that due to the dispersion of an organization's knowledge throughout itself, the organization incurs higher information gathering costs than individuals (due to the need for relearning things already known elsewhere in the organization), and higher lost opportunity costs

(caused by not having information in one part of the organization available to other parts).

To some extent these characteristics of the organization's control of its knowledge may seem inevitable. If we assemble a complex system of individuals, how can it be otherwise?

In the remainder of this paper we will continue to expand on this concept of corporate memory and examine implications for designing a system to aid an organization to more effectively use its memory.

2.0 WHY COMPUTERIZE A CORPORATE MEMORY?

To facilitate a discussion of possible benefits in computerizing corporate memory, let us consider the dimensions which we might use to describe an organization's memory, computerized or not.

1. Availability: who has access to the information.
2. Access Time: how long does it take to retrieve the information.
3. Access Procedure: how easy is it to retrieve information.
4. Updatability: what is required to update the memory.
5. Stability: how reliable is retention of information.
6. Consistency: can different segments of memory be inconsistent with each other.
7. Control: is information the property of the individuals or the organization.
8. Validity: how accurate is the information.
9. Physical Form: specifically is it machine readable.
10. History: is a history maintained or only current state information.
11. Procedural/Data: is information of factual or procedural nature.
12. Implicit/Explicit: is information explicitly recorded or implicitly understood.

We see computerization providing increased availability, decreased access time, increased stability, moving control towards the organization, increased consistency, increased validity, increased explicitness, and easier maintenance of histories. There are both pros and cons of achieving all of the above benefits.

The two cases mentioned at the beginning of this paper (retaining retired employees as consultants and Lanier's incentive system for sales leads) both show benefits that can be realized from increased availability and decreased access time. We get things done (sales or whatever) faster and possibly even accomplish some things that might not have been accomplished without the information obtained.

Additional benefits could be realized in the reduced training times. New employees would now get 'plugged in' to the necessary information networks more quickly. This type of facilitation of information flow becomes more important as firms grow in size, firms become more geographically dispersed, and the labor force becomes more mobile.

A final area in which the computer can help is that of amplification and attenuation of information. The computer can be very effective in the areas of monitoring information flows for items defined as being of interest (this is an area of research known as alerting [5, 3, 15]). For example, the system could scan the news ticker for stories containing keywords of interest, and send them by electronic mail as they are detected. There is also the possibility of the system using models to infer implications of various data.

3.0 ORGANIZATIONAL CONSIDERATIONS

There may be organizational barriers to creating a comprehensive corporate memory. First, as Galbraith [7] points out, an organization in which every component is in total communication with every other component would likely result in overburdening information flows. Therefore, we take steps to limit the complexity of information communication. We attempt to make the components independent; we try to define what information is necessary to be communicated and to whom, etc. These measures will inevitably lead to segmented memory, but hopefully, segmented only to a degree in which the benefits of simpler communication patterns outweigh the costs of more complex patterns.

While Galbraith's framework has in the past supported the economic advantage of the segmented memories we see in organizations today, the framework also establishes the development of systems that make more complex information flows possible without information overload as an alternative. We feel that the technologies we review in the next section make feasible a wider dispersal of information than many systems currently facilitate.

The second aspect of organizations which seems to argue the inevitability of an organization's memory being segmented is that organizations are composed of human individuals. Argyris [1] claims that due to problems in the areas of goal congruence (e.g. the difficulty of designing an incentive system that encourages complete cooperation among organization members) and people's fear/aversion of automation and the computer make the development of systems that will make information available everywhere in the organization an infeasibility.

The fear/aversion we can hope to counter by drawing upon developments in the ergonomics of designing human-computer interfaces. Fear/aversion and to some degree the problem of goal congruence can be countered by the incentive of convenience (i.e. design the system to produce a benefit to the individual as well as to the organization). Further insight into the goal congruence problem will hopefully come from the developing field of organizational design. Until then we will have to choose with care the settings for our systems development.

Many authors have recognized the need for different information systems to deal with individuals at different levels in the organizational hierarchy. It is our contention that with corporate memory systems, the more relevant discriminant is "centrality" of the individual. Each of us is familiar with an office where a long time employee, often administrative assistant level, is "the one to see if you want to get something done." Basically, those who are more central, i.e. crucial, to the flow of information derive some power from this centrality. As Machiavelli put it, 'knowledge is power'. Therefore one should be aware that whenever he tries to tamper with an organization's information structure, he is tampering with the power structure as well, and this can cause resistance by members of the organization. This should not necessarily be an argument against

trying to alter information structures, but that we should take this resistance into account when designing and implementing systems. This implies providing a system which serves individual needs as well as organizational needs, not designing a system which will fail without complete usage by the entire organization, etc.

A second danger comes from the problems mentioned earlier related to goal congruence. If different segments of the organization have goals which are in conflict with each other, and we institute a system which gives them more complete knowledge of each others actions, this may result in undesirable gaming activities. For example, a production organization which is measured on keeping a low inventory level may be in conflict with a marketing organization which wishes to be able to meet any demands quickly. If production has access to the data marketing uses for forecasting, they might not interpret the data with the same degree of optimism and thereby decide to lower planned production levels. Such situations would have to be corrected by altering the incentive system or by limiting the scope of information availability created by the system.

4.0 TECHNOLOGIES

Extensive work is going on in the areas of Personal Computing [9] and Decision Support Systems [11] that is oriented toward using OR and computer technologies in interactive, user controllable systems for Personal Support. By Personal Support we mean to emphasize that the technologies are assisting an individual user in working on his problems. The individual's problems will often be related to a task/problem of the organization; however, in Personal Support it is the individual who acts as the link between the system and the organization and its interests. In this environment it is possible that the individual uses the system to pursue goals of his own which are not completely consistent with the organization's.

What are the implications of keying on Organizational Support rather than Personal Support? In well structured tasks that do not exhibit problems in goal congruence, the problem simply becomes one of developing a system to facilitate the flow of information needed for coordination where interdependencies exist. An example of such a system would be an airline

reservation system. Here we have up to date information on actions taken by many individuals being made available to others. However, as the tasks become less structured the information captured by such transaction processing systems is no longer adequate for communication of the organizations body of knowledge.

The technologies of Office Automation are especially well suited to assisting in the creation of a corporate memory system. Here we take a broad view of what is encompassed by Office Automation; e.g. Word Processing, Electronic Mail, Teleconferencing, Information Storage and Retrieval, Personal Assistants and task management. With these technologies, large sources of information are now available in machine processable form. Possibilities are being explored in the area of teleconferencing [10] where systems are provided for storing, retrieving, summarizing, etc. discussions carried out using electronic mail.

Techniques for gaining more knowledge and control of office processes are also being studied [14, 17]. These techniques will permit some of the procedural portions of corporate memory to be put on a computer. For example, large portions of the process of editing scientific and professional journals are now "understood" by the SCOOP system at Wharton. This means both that the process has been extensively automated, but also that we now have recorded in our corporate memory the steps in this process, and this knowledge can be made available to others facing similar tasks.

What technologies can aid less structured tasks with incongruent goals? Possibilities of addressing less structured tasks are opening up through developments in the area of Artificial Intelligence. An example of such possibilities is a system developed at MIT called NUDGE [8]. The purpose of NUDGE is to handle scheduling of meetings. NUDGE has knowledge of peoples schedules, their preference for meeting times, and their expertises and responsibilities. As an illustration of NUDGE's function, consider a case where the group/organization whose schedules are being managed by NUDGE is a law firm servicing corporate clients. A client calls up and says he will be in town tomorrow and would like to meet with someone about a particular case the firm is handling. In a current law office, if the lawyer in charge of the case is free tomorrow then an appointment is easily set up. If he isn't free we are launched into a search pattern of 'can we juggle the lawyer's schedule', 'who

else could talk to the client', etc. Meanwhile the client sits on hold listening to Muzak or is told he will be called back. The NUDGE system when presented with this meeting request would in a much more automated manner start asking and in some cases answering these questions, giving us an answer much more quickly. MIT's work has shown us the technical feasibility of a system such as this, but we still have little or no knowledge of the impact/feasibility of introducing such systems into real world environments.

Even with the information dissemination facilities of office automation, the processing power of personal DSS, and artificial intelligence techniques for knowledge representation, corporate memory systems will not be used if the person/machine interface is difficult to learn. The Spatial Data Management Project [6] is working on a user interface which makes use of graphics, sound, voice and text in a system for exploring data bases of various types (referred to as 'information spaces'). This results in a much more manageable and informative system than the usual teletype or CRT. Tests have shown that a subject with only a few minutes of training can successfully begin exploring 'information spaces'.

5.0 FUTURE RESEARCH

The goal of our current project is to implement a prototype corporate memory for a portion of a real organization over the next 18 months. This system will be built on top of existing components from the Wharton Office Automation System, the DATA database management system, SCOOP, and decision support aids. There are large systems problems in attempting to unify a collection of disparate systems. Part of this will be accomplished through user interface construction, part through new coding.

More importantly, there are several areas which will demand more research. The first is the area of amplification and attenuation of information. Human memories are very good at these functions. We all find it harder to remember events of long ago than recent events. Events which we deemed "significant" when they occurred are amplified, while other items are attenuated. For example, while our visual memory system has stored the clothing being worn by the people in a room, most of us so strongly attenuate this information that we have a hard

time recalling what anyone was wearing even a few minutes later. We have begun work on information and database systems which will permit information to be attenuated or amplified through various weighting and filtering schemes, while retaining the advantage of human memory - never really forgetting anything.

A second area of research is that of building systems to store and retrieve the less structured data that characterizes much of what will be in corporate memory. Right now, it appears that such systems must be domain specific, and we can borrow from the artificial intelligence community the techniques of frames, semantic nets, and production systems for representing these structures. However, except for trivial domains, these are difficult to build. We wish to explore the possibility of establishing a set of more general organizational knowledge systems (e.g., banking, insurance, real estate, memo handling), which would only have to be fine tuned for individual situations.

6.0 CONCLUSIONS

We have begun to explore the implications of assuming that information systems are meant to serve organizational, rather than individual, goals and purposes. This has led us to a development project for a corporate memory system, which would be accessed by individuals, but designed to maximize the objectives of the organization as an entity. The greatly facilitated communications provided by office automation is a first step on this road. We shall continue to report to the research community on the next steps.

7.0 ACKNOWLEDGEMENTS

The authors wish to acknowledge the useful conversations they have had with Professors Eric K. Clemons and Peter Keen at The Wharton School. This research was supported in part by the Office of Naval Research under Contract N00014-75-C-0462.

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